NATIONAL WILD FISH HEALTH SURVEY

California-Nevada
Fish Health Center

ANNUAL REPORT FY 2001

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Annual Progress Report FY 2001

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California-Nevada Fish Health Center

Center staff conducted the National Wild Fish Health Survey (NWFHS) in FY 2001 by conducting sample collections, performing laboratory assays, and entering data in the NWFHS Database.

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OVERVIEW

Fiscal year 2001 marks the 5th year of the National Wild Fish Health Survey. The California - Nevada Fish Health Center (CA-NV FHC) continues to enjoy the support of many Federal, State, Tribal, and private cooperators in conducting the NWFHS. The Survey continues to offer much needed fish health information for a variety of other disciplines and endeavors which support both the U.S. Fish & Wildlife Service's priorities in restoration and conservation management, and the needs of our partners. In reviewing the direction of the Survey in the past five years, there appears to be three major categories of technical support we provide based on requests of our partners:

Restoration
Contaminants
Pathogen Surveys

Restoration work for several State and Federal projects continues to be the highest priority for support from the NWFHS. Many geographical areas that are planning, implementing, or monitoring restoration projects need baseline data of the fish pathogens that exist in the watershed.

Long term contaminants monitoring is the next most important area of support the Survey offers as fish health assessment is a critical factor in understanding the biological effects of contaminants on immediate and long-term health of fish communities.

And finally, there still continues to be a need for monitoring existing and new pathogens of interest. For example, surveys were conducted to monitor endemic pathogens such as Infectious Hemorrhagic Necrosis Virus (IHNV) and *Myxobolus cerebralis* to determine what effect these pathogens may be having on threatened or endangered species. In addition, there is strong interest by State partners to develop baseline data for pathogens found elsewhere in the United States and to determine if these organisms exist in California and Nevada. Examples of pathogens that may be new to our area are Largemouth Bass Virus (LMBV) and Viral Hemorrhagic Septicemia Virus (VHSV). VHSV has recently been found in Pacific sardines & mackerel in commercial catches off Southern California, but the full geographic range is not currently known.

In addition to surveying for specific pathogens, many National Wildlife Refuges are interested in cataloguing species abundance and distribution, and want to include a fish health assessment as a component of the overall ecosystem health of their refuge.

Obviously, several projects conducted this year overlap in one or more of these general categories and for the purpose of this report they are used simply to alert the reader to the type of support that is being requested from our partners and provided under the NWFHS.

RESTORATION ACTIVITIES

Lahontan Cutthroat Trout, Nevada

Restoration of the threatened Lahontan cutthroat trout is a high priority for the State of Nevada and the U.S. Fish & Wildlife Service. Remnant populations of this distinct genetic strain are used to implement enhancement programs that utilize the best-suited sites for reintroduction in native waters. Fish health information provides knowledge about the current health status of these populations to help ensure their success, but it also prevents the spread of disease to new locations if pathogens are detected in the existing broodstock populations. Several watersheds containing Lahontan cutthroat trout and other trout species were sampled for all major fish pathogens. An emphasis was placed on sampling for *Myxobolus cerebralis*, the parasite that causes Whirling Disease, because this pathogen is endemic to many waters throughout Nevada.

Desert Creeks, Mineral Co., NV

Three species of trout were submitted in October 2000 for examination. Of these, the Brook trout were progeny of Gallagher State Fish Hatchery broodstock, the others (brown & rainbow trout) were from naturally reproducing populations. Whirling Disease (*M. cerebralis*) testing was negative in the brown & rainbow trout (the brook trout were too young). This was an important finding; it suggests that this population is healthy and

doing well despite the endemic history of Whirling Disease in this geographic area. Pathogen testing detected *Renibacterium salmoninarum* in moderate to high levels in these wild fish populations by Enzyme Linked Immunosorbant Assay (ELISA); however, corroborative PCR testing was negative. Other bacterial and viral pathogen testing was negative.

Rough Creek, Lyon Co., NV

Cutthroat-Rainbow trout hybrids were submitted to the lab in October 2000 for examination. Like the Desert Creek fish, Whirling Disease testing was negative. Fish from this creek have tested negative in the past,[1] suggesting that Whirling Disease is not endemic in this particular stream although it has been found in the watershed. Pathogen testing detected *Renibacterium salmoninarum* in moderate to high levels in these wild fish populations by Enzyme Linked Immunosorbant Assay (ELISA); however, corroborative PCR testing was negative in the samples submitted. Other bacterial and viral pathogen testing was negative.

Truckee River, Washoe Co., NV

Eight sites along the Truckee River were sampled in October 2000 by Oregon State University personnel. Four species of trout were collected in these eight sites, with the majority being non-native brook and brown trout. Of the fish collected, the heads were sent to the Center lab for Whirling Disease testing. *Myxobolus sp.* was detected in samples from three sites – Eagle Picher, Derby Dam, and Verdi Power Dam. Confirmation testing was preformed and was positive for *M. cerebralis* the pathogen that causes Whirling Disease, in the samples from Eagle Picher site. Whirling Disease was known to occur in the Truckee River, and this confirms that the pathogen is still present. It's immediate impact on fish populations is still unknown.

Flag Spring, Nye Co., NV

Located in the Kirch Wildlife Management Area (State of Nevada), Flag Spring is the source of fresh water in an otherwise arid environment. Native populations of Desert suckers and Speckled dace were found to be significantly declining by refuge personnel in April 2001. Samples from the remaining population were sent to the lab for examination to determine if a pathogen was responsible for the dramatic decline. Fish tested were negative for pathogens, which leaves the question to other possible causes which could be water quality/quantity or increased predation or a combination thereof.

San Felipe Creek (San Diego Co.), CA

Located in Anza-Borrego Desert State Park, San Felipe Creek is an important water source – liquid gold – in an otherwise desert environment, and located in a much urbanized county. The

[1] 1975 Grey literature, 3 fish were tested.

State Park is the largest desert state park in the contiguous United States and within it's boundaries permanent and intermittent streams are home to native fish and amphibians. As a result of the urbanization of San Diego County, much habitat was lost to species that evolved to live in this specialized habitat. In conjunction with various land owners, a Comprehensive Conservation Plan is being developed for the creek and surrounding land.

US Geological Survey biologist became concerned when native and exotic fish were found to be infected with the non-native parasites *Ichthyophthirius multifiliis* (Ich), *Bothriocephalus acheilognathi* (Asian tapeworm), and *Lernaea cyprinacea* (Anchor worm). These parasites may potentially result in significant negative effects on the long term viability of the federally listed Unarmored Sticklebacks and the Red-legged Frog. Also, the USGS Biologists were concerned that fish from this site might be infected with an iridovirus as was found in diseased threespine stickleback and red-legged frog tadpoles from Redwood National Park in Northern California. Fish were sent to the Fish Health Center for examination for parasites and diseases, and to provide a baseline of information for this important desert aquatic habitat. No parasites or fish pathogens were found on the fish examined.

San Francisquito Creek (Los Angeles Co.), CA

Like San Felipe Creek, San Francisquito Creek is located in a very urbanized county. The creek is in the San Gabriel mountains, part of Angeles National Forest, approximately 40 miles north east of downtown Los Angeles. In the early 1900s a dam was built on the creek to provide water for the growing city of Los Angeles, but the dam failed in 1928 and was never rebuilt. The dam failure resulted in the second largest loss of life from a disaster in the history of California. The creek provides habitat for native fish and amphibians, otherwise lost with urbanization of southern California. In conjunction with various land owners, a Comprehensive Conservation Plan is being developed for the creek and surrounding land.

Again, US Geological Survey biologist became concerned to find native and exotic fish to be infected with the non-native parasites *Ichthyophthirius multifiliis* (Ich), *Bothriocephalus acheilognathi* (Asian tapeworm), and *Lernaea cyprinacea* (Anchor worm). These parasites may potentially result in significant negative effects on the long term viability of the federally listed Unarmored Sticklebacks and the Red-legged Frog. Fish were sent to the Fish Health Center for examination for parasites and diseases, and to provide a baseline of information for this important desert aquatic habitat. The parasite *Gyrodactylus* was found on some of the Arroyo chubs submitted, but no viral or bacterial pathogens were found.

San Joaquin River Basin (San Joaquin, Stanislaus, Tuolumne, and Merced Rivers), CA

Declining San Joaquin basin Chinook salmon populations have been a focus of study for many years. Monitoring of emigrating juvenile salmon for population estimates, migration timing, growth characteristics, and survival indices has provided important management data for this key aquatic resource. A comprehensive pathogen survey utilizing the existing monitoring sites was desired to complement the existing knowledge base. Pathogen and physiological samples were

collected 2-3 times at each of four monitoring sites through the spring migration period. *Renibacterium salmoninarum* infections were detected in 7-50% of juvenile Chinook from the San Joaquin, Stanislaus, and Tuolumne Rivers. Light infections of the PKX myxosporean (causative agent of Proliferative Kidney Disease) were detected in 5-10% of juvenile salmon from the Tuolumne and San Joaquin Rivers, and heavy PKX infections with clinical disease were found in 86% of juvenile Merced River Chinook.

Tijuana Slough NWR, San Diego, CA

This coastal wetland is southern California's only coastal lagoon not bisected by roads or rail lines. The refuge is one portion of public land that is included in the Tijuana River National Estuarine Research Reserve. The Slough's habitats include open water, tidal salt marshes, beach dunes, riparian vernal pools and upland surrounded by residential neighborhoods. Despite being in a highly urban setting, and on the US-Mexico border, the Slough remains one of the most productive ecosystems. In the early summer, refuge staff became concerned with point and non-point pollution, and was also interested in a pathogen survey of urban refuges containing endangered species. In July 2001, refuge staff sent three species of fish for examination. No fish pathogens were found in the fish examined.

Trinity-Klamath Rivers, CA

Natural populations of coho salmon (listed as threatened), chinook salmon (candidate ESU), and steelhead trout (candidate ESU) have declined significantly in both the Klamath River and its tributary the Trinity River. Restoration efforts have included litigious river flow changes, habitat restoration projects, and hatchery supplementation. In cooperation with biologists from the Yurok tribe, USFWS Arcata FWO, and California Department of Fish & Game, the Fish Health Center performed health monitoring on juvenile salmonid out-migrants in the lower Trinity River, lower Klamath River and estuary from June 1 through July 30, 2001. The emphasis of the monitoring project was to identify the primary cause of disease in moribund specimens and was not designed as a general pathogen survey. Two parasitic infections, common to the Klamath River, were the primary disease issues identified in the out-migrants. The incidence of infection of Ceratomyxosis was seen in up to 50 % of some collection groups while a kidney myxosporean infection was detected in 61% of the juveniles. The unidentified kidney myxosporean induced a severe glomerulonephritis condition in the affected chinook juveniles.

Table. Incidence of infection (specimens positive / total specimens (%)) of *Ceratomyxa shasta*, kidney myxosporean (Kd myxosp.), glochidia in the gill, metacercaria in the kidney, *R.*

salmoninarum in kidney (RsalDFAT=Fluorescent antibody test), *Aeromonas* / *Pseudomonas* cultured from kidney tissue of moribund fish (A/P), *Flavobacterium columnare* from TYES cultures (Fc-TYE) and imprint of gill lesions (Fc-gill), and virus in kidney-spleen pools. Samples were collected during June and July 2001 from out-migrant chinook salmon.

	Klamath R.		**Klamath Estuary**		**Trinity R.**		**Basin-wide**	
C. shasta	17/34	50%	9 / 30	30%	0 / 36	0%	26 / 98	27%
Kd. myxosp	22 / 25	88%	27 / 30	90%	2 / 29	7%	51 / 84	61%
Glochidia	0 / 26	0%	0 / 13	0%	4 / 23	17%	4 / 62	6%
Metacercaria	22 / 47	47%	7 / 30	23%	30 / 130	23%	57 / 207	28%
Rsal (DFAT)	0 / 47	0%	0 / 30	0%	0 / 130	0%	0 / 207	0%
A/P	3 / 13	23%	10 / 25	40%	3 / 7	43%	16 / 45	36%
Fc-TYE **Fc-Gill**	1 / 2 0 /1	50% 0%	0 / 6 ND	0% ND	1 / 22 6 / 8	5% 75%	2 / 30 6 / 9	7% 67%
Viral	0 / 30	0%	0 /14	0%	0 / 14	0%	0 / 58	0%

PATHOGEN SURVEYS FOR NEW OR ENDEMIC DISEASES

Sacramento River (Lower Reach), CA

Infectious Hematopoietic Necrosis Virus (IHNV) infection is common and widespread in adult Fall-run chinook salmon in the Sacramento River system. This virus appears to be quite prevalent in both hatchery and natural chinook stocks of the region. In conjunction with monitoring crews from the USFWS Stockton Fisheries Resource Office, monthly sampling trips took place from Jan-July. Thirteen species of fish were sampled from the same habitat that is

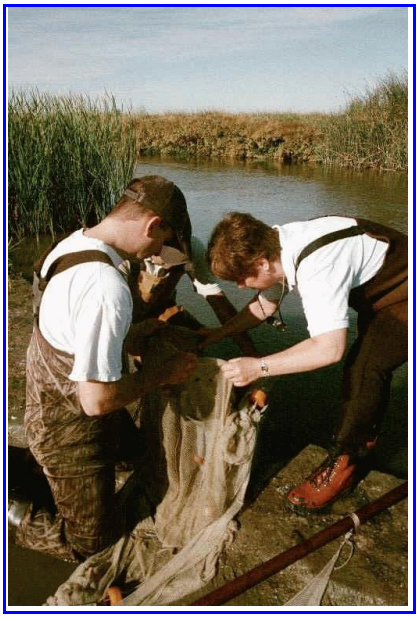
used by juvenile out-migrant chinook salmon. No fish health samples were collected from juvenile salmon when they were caught in the beach seine net. No viral or bacterial pathogens were found in the fish sampled.

Delta Region of the Sacramento, San Joaquin, American, & Mokelumne Rivers, CA

Declining chinook salmon populations in California's Central Valley continues to drive an intense restoration effort of this valuable resource which is a key element of the state's aquatic biodiversity. Infectious disease can influence survival due to both direct mortality and reduce physical performance during out-migration of juveniles. This field season a large effort was placed on sampling fish that utilize the same habitat as out-migrant juvenile salmon. Fish health samples were collected from 37 sites, in conjunction with regular monitoring by the Stockton FRO. No viral or bacterial pathogens were found in the fish sampled; however, a *Myxobolus sp.* was found in Sacramento Pikeminnow. More than one species of *Myxobolus* are endemic to the Central Delta region, and this one was not *M. cerebralis* which causes Whirling Disease.

Stone Lake NWR, CA

Stone Lake NWR was established in 1994 and contains some of the last remaining fresh water lakes in the Central Valley of California, providing both seasonal and permanent wetlands. Located just south of the city of Sacramento and part of the Sacramento-San Joaquin Rivers Delta system, the refuge supports a rich variety of wildlife. The variety of fish species that are within the refuge made it an excellent sampling site for the Survey. Particular pathogens of interest at this location were Infectious Pancreatic Necrosis Virus and Largemouth Bass Virus. Sampling at the refuge continued this fiscal year with a trip in October 2000. One hundred forty one fish from nine species were sampled from South Stone Lake. No reportable fish pathogens were found.



CONTAMINANTS

San Luis - Kesterson NWR, CA

This refuge has a history of selenium contamination since the 1980s. The San Luis Drain (SLD) had been conceived as a means to dispose of agricultural drain water generated from irrigating farm fields supplied by the Central Valley Water Project. The constructed portion of the SLD had been used

only to convey subsurface agricultural drain water from the Westlands Water District in western San Joaquin Valley. Farms adjacent to San Luis-Kesterson NWR discharge their agriculture drain water through wetland channels in the refuge. This drain water was found to contain elevated concentrations of selenium, boron, chromium, molybdenum, as well as high concentrations of various salts that disrupt the normal ionic balance of affected aquatic ecosystems. In addition, unknown concentrations of agricultural chemical residues (fertilizers and pesticides) may also further contaminate this drain water[2].

Beginning in FY 2000, Center staff have accompanied Contaminants monitoring crews to the refuge. On the quarterly trips, fish were captured with beach seine nets, so a majority of fish sampled were small, often too small to do a full pathogen analysis. As the water temperatures increased with the summer months, fish were found to be infected by *Lernaea* (Anchor worms) and *Neascus* (Black grub) and exhibited clinical signs of selenium toxicity (lordosis).

[2] Grassland Bypass Project Annual Report 1998-1999.

Clear Lake, Lake Co., CA

California Department of Fish & Game has been monitoring fish in Clear Lake due to elevated levels of mercury in found in fish since the 1970's. The Sulphur Bank Mercury Mine, a former mercury mine, and now an EPA Superfund Site, is located on the shore of the lake. The University of California, Davis - Clear Lake Environmental Research Center has been researching mercury in Clear Lake since 1992. They have been monitoring the transformation of inorganic mercury to the more toxic organic form which can occurs under certain physical and chemical conditions, when microorganisms (bacteria) in the sediment convert inorganic mercury to the organic mercury as a byproduct of their metabolism. Small animals that live in the sediments (such as worms and insect larvae) may then absorb this toxic organic mercury from the sediment, which is in turn passed on to the animals that feed on them. In this way, the contaminated sediments adjacent to the old mercury mine may be a significant source of mercury to the Clear Lake food chain[3].

In addition to mercury contamination, additional concern arose when fish survey crews found fish exhibiting clinical signs of fish disease. A small percentage of adult Largemouth Bass presented with petechial hemorrhaging especially at the base of the fins. Center staff accompanied survey crews (CDFG & UC Davis) in October 2000 to collect fish health samples from the fish. One of the symptomatic fish tested positive for *Aeromonas hydrophila* which is an opportunistic bacterial pathogen and will infect fish that are stressed or have a compromised immune system. The fish sampled did not test positive for any of the major pathogens, in particular Largemouth Bass Virus.

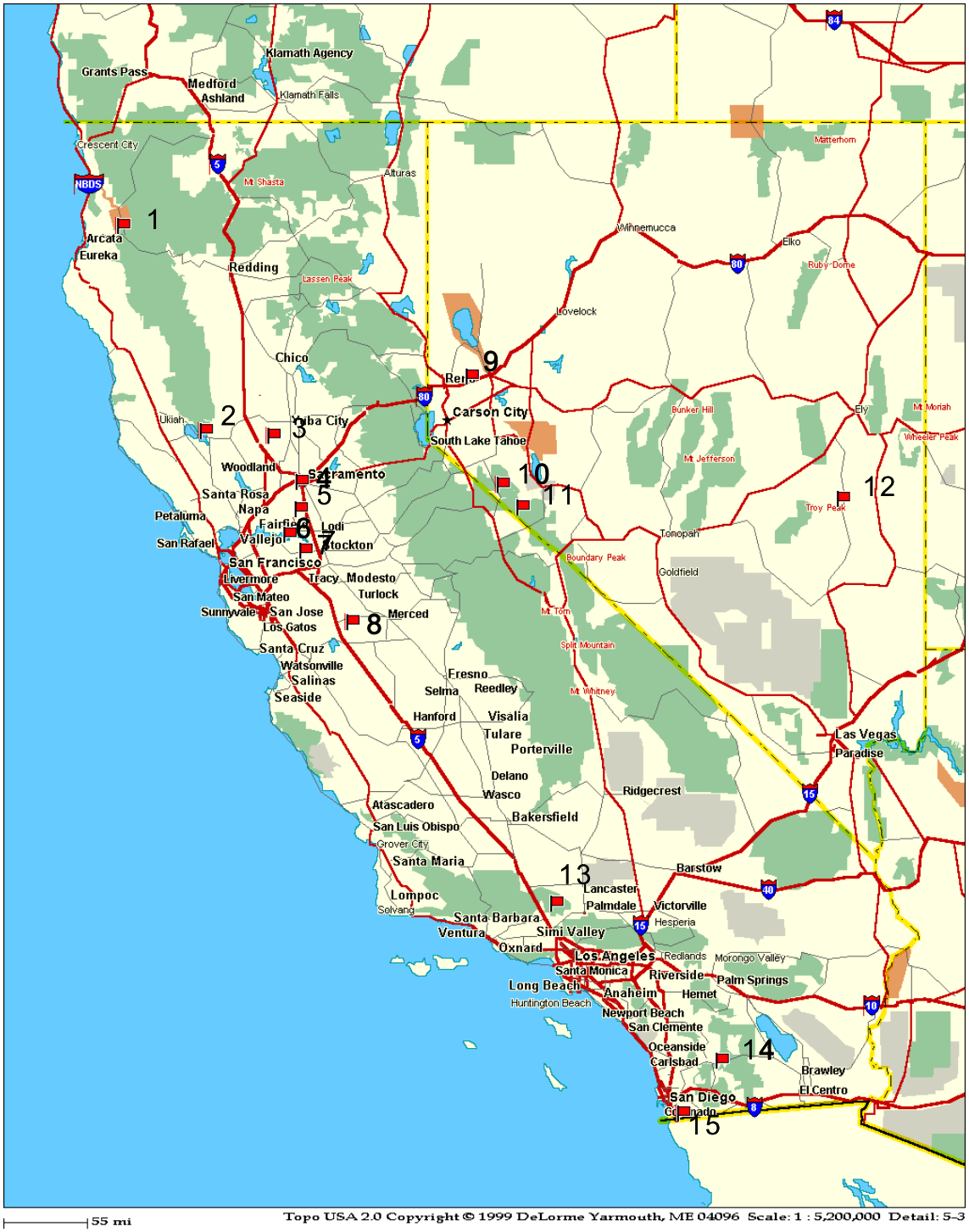
[3] UC Davis - Clear Lake Environmental Research Center, Web site

PARTNERSHIPS

List of Partners corresponds to Sample Sites on Map

	Map Site	Partners
1.	Trinity & Klamath Rivers, CA	USFWS - Arcata Fisheries Resource Office Yurok Tribal Fisheries California Dept. of Fish & Game
2.	Clear Lake, CA	CDFG University of California - Davis
3.	Middle Reach Sacramento River, CA	USFWS - Stockton Fisheries Resource Office CA State Parks
4.	Lower Sacramento River, CA	USFWS - Stockton FRO Sacramento Co. Parks
5.	Stone Lakes NWR, CA	USFWS - Refuges
6.	Central Delta of the Sacramento, San Joaquin, & Mokelumne Rivers, CA	USFWS - Stockton FRO
7.	San Joaquin River Basin, CA (San Joaquin, Tuolumne, Stanislaus, & Merced Rivers)	CDFG CA State Parks Merced Irrigation District Oakdale Irrigation District South San Joaquin Irrigation District Natural Resources Scientists, Inc. SP Cramer & Assoc. Tridan Project USFWS - Stockton FRO
8.	Kesterson/San Luis NWR, CA	USFWS - Refuges USFWS - Contaminants CDFG
9.	Truckee River, NV	Nevada Division of Wildlife Oregon State University
10.	Desert Creek, NV	NDOW USFWS - NV Ecological Services
11.	Rough Creek, NV	NDOW USFWS - NV ES
12.	Flag Spring, NV	NDOW USFWS - Refuges
		US Geological Survey - San Diego Field

	Map Site	Partners
13.	San Francisquito Creek, CA	Station US Forest Service - Angeles Natl. Forest CDFG CA State Parks
14.	San Felipe Creek, CA	USGS - San Diego Field Station CDFG CA State Parks
15.	Tijuana Estuary, CA	USFWS - Refuges San Diego State University - Pacific Estuarine Research Lab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Klamath Agency
Klamath Falls
Crescent City
Mt Shasta
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Chico
Ukiah
Yuba City
Carson City
South Lake Tahoe
Woodland
Sacramento
Santa Rosa
Napa
Petaluma
Fairfield
Vallejo
San Rafael
Lodi
Stockton
San Francisco
Livermore
Tracy
Modesto
Turlock
San Mateo
Sunnyvale
San Jose
Merced
Los Gatos
Santa Cruz
Watsonville
Salinas
Seaside
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Porterville
Delano
Wasco
Ridgecrest
Atascadero
Bakersfield
San Luis Obispo
Grover City
Santa Maria
Lompoc
Solvang
Santa Barbara
Ventura
Simi Valley
Oxnard
Los Angeles
Santa Monica
Long Beach
Huntington Beach
Anaheim
Riverside
Redlands
Morongo Valley
Palm Springs
Hemet
Newport Beach
San Clemente
Oceanside
Carlsbad
San Diego
Coronado
Barstow
Lancaster
Palmdale
Victorville
Hesperia
Las Vegas
Paradise
Brawley
El Centro
Winnemucca
Elko
Ruby Dome
Lovelock
Matterhorn
Bunker Hill
Ely
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Wheeler Peak
Mt Jefferson
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Tonopah
Boundary Peak
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Topo USA 2.0 Copyright © 1999 DeLorme Yarmouth, ME 04096 Scale: 1 : 5,200,000 Detail: 5-3

LITERATURE CITED

Beckon, William N. Biological Effects section of Grasslands Bypass Project Annual Report 1998-1999. USFWS/US Bureau of Reclamation gray literature.

UC Davis - Clear Lake Environmental Research Center, Web Site: (http://ice.ucdavis.edu/ucdclerc/ClearLakeWatershed.html).